Pressure and Temperature Law

- If you read the warning on an aerosol can, you will see a caution about the danger of the can exploding if heated

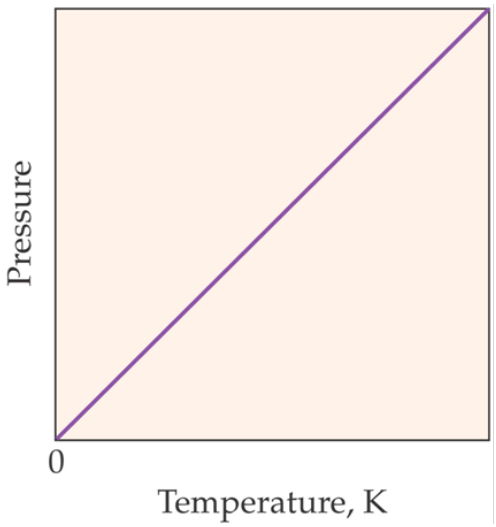
- As you might expect then, raising the temperature, increases the pressure of a gas

Pressure - Temperature Law

- It has been discovered that the pressure of a gas is *directly proportional* to the temperature in Kelvin.

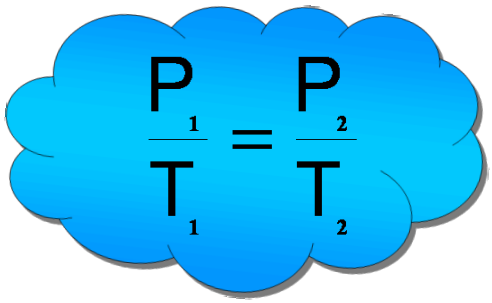
- This is the ***Pressure -Temperature Law***

- $P \propto T$ at constant temperature.
- Notice that the Pressure - Temperature law gives a straight line graph.



Equation for Pressure - Temperature Law

· Let's take a sample of gas at T_1 and P_1, and change the conditions to T_2 and P_2. If volume and the amount of gas are constant, we can write:



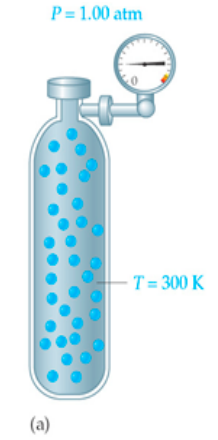
Ex. A steel container of nitrous oxide at 15.0 atm is cooled from 25 °C to – 40 °C. What is the final pressure at constant volume?

Illustration of Pressure-Temperature Law

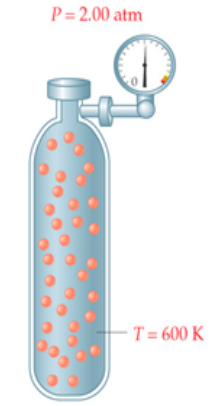
- Below is an illustration of the Pressure-Temperature law.

- As the temperature of a gas in a steel cylinder increases, the pressure increases.

- Remember, the 2 variables that are constant are:



(a)



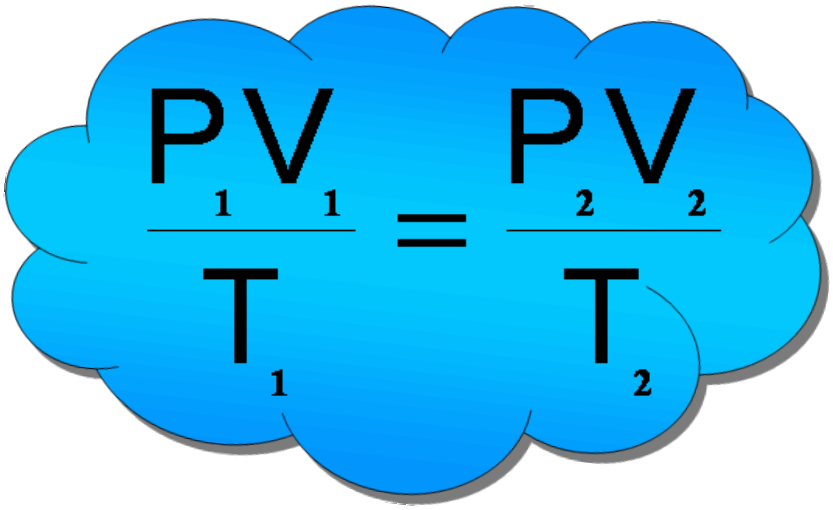
(b)

Combined Gas Law

· When we introduced Boyle's, Charles's, and the Pressure-Temperature law, we assumed that one of the variables remained constant.

· Experimentally, all three (temperature, pressure, and volume) usually change.

· By combining all three laws, we obtain the ***combined gas law***:



What do you think must stay constant for us to use this law?

Let's Try an Example

· In a combined gas law problem, there are three variables: *P*, *V*, and *T*.

· Let's apply the combined gas law to 10.0 L of carbon dioxide gas at 300 K and1.00 atm. If the volume and Kelvin temperature double, what is the new pressure?

First, summarize what the question is telling you.

	Pressure	Volume	Temperature
Initial	1.00 atm	10.0 L	300 K
Final	? P2	20.0 L	600 K

Let's Try another example

If I initially have a gas at a pressure of 12 atm, a volume of 23 liters, and a temperature of 200 K, and then I raise the pressure to 14 atm and increase the temperature to 300 K, what is the new volume of the gas?